Improved Columbia returns to service

by James Hartsfield

n the eve of the 20th anniversary of its maiden voyage, *Columbia* is returning to service fresh from a year and a half of maintenance and upgrades that have made it better than ever.

"As its 20th birthday approaches, *Columbia* is fit to fly for many more years," Space Shuttle Program Manager Ron Dittemore said. "It is safer and more capable than it has ever been, a result of the thorough maintenance and continuous improvements that have been incorporated regularly into the shuttle fleet."

More than 100 modifications and improvements have been made to *Columbia*, highlighted by the installation of a new "glass cockpit" which replaced mechanical instruments with nine full-color, flat-panel displays. The new cockpit is lighter, uses less electricity and sets the stage for the next generation of improvements, a "smart

cockpit" in development during the next five years that will make

the cockpit more user-friendly. *Columbia* is the second of NASA's four space shuttles to be fitted with the new "glass cockpit." The Space Shuttle *Atlantis* was the first to fly in space with the "glass cockpit" on mission STS-101 in May 2000. The work on the "glass cockpit," technically called the Multifunction Electronic Display Subsystem (MEDS), has been overseen in large part by Jim Newsome, subsystem manager for MEDS in the Avionics Systems Division at JSC.

Work at Palmdale on *Columbia* began when it arrived there from Florida on Sept. 26, 1999. Other improvements that were made include weight reductions that have increased the amount of cargo *Columbia* can carry to orbit by hundreds

of pounds. To save weight, almost 1,000 pounds of unused wire–leftover from equipment and sensors that were used on *Columbia* for only the first few space shuttle test flights–were removed.

Due to multiple instances of wiring damage that were found in the shuttle fleet in 1999, comprehensive inspections of 95 percent of *Columbia's* more than 200 miles of wire were performed at Palmdale. To prevent such damage from recurring, technicians smoothed rough edges throughout the

protective tubing. Also, about 1,500 feet of wiring was removed and replaced with new wiring.

The removed

shuttle and encased wiring in

high-traffic work areas in

wiring will be used for testing to verify that predictions of the characteristics of aging on shuttle wiring are accurate.

"The wiring work, the inspection and the removal of wiring was probably the most significant thing done at Palmdale in terms of time and manpower required," explained John Mulholland, deputy manager for operations in the Space Shuttle Vehicle Engineering Office. "It may also be one of the most significant safety enhancements we have made."

Normally, shuttle modifications are planned out as much as a year in advance, Mulholland added, but the wiring work on *Columbia* was planned

and begun in only a few months. Key to the success of the quick work on wiring enhancements was Doug White, director of operational requirements in the United Space Alliance's Orbiter Elements Office.

"The team did a great job quickly identifying and laying out what needed to be done and getting it in work," White said. "The effort really stretched coast-to-coast. People were involved from Houston, Florida, Boeing in Huntington Beach, California, and Boeing in Palmdale."

Such inspections and protective measures will be a regular feature of all future shuttle maintenance periods. Some work also was performed to better separate duplicate wires that provide power to critical shuttle systems, ensuring that a problem in one area would not affect both sets of wires.

The vast majority of such instances are avoided in the shuttle's original

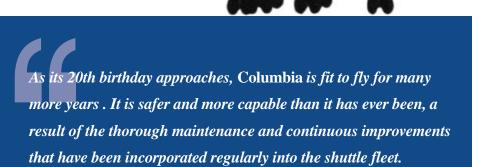
design, but work led by Frank Alanis of JSC Engineering's ` Energy Systems Division was a significant contribution

to identifying a few areas in need of modification.

Also at Palmdale,

preliminary preparations were made that could allow *Columbia* to use a space station docking system, enabling it to join the rest of the shuttle fleet as a courier to the International Space Station in the future if needed. In addition, *Columbia's* crew cabin floor was strengthened, the heat protection on its wings was enhanced and protection from space debris was added to its cooling system, making it a safer spacecraft.

While *Columbia* was in California, technicians scoured the shuttle during months of intensive structural inspections, using the latest technology to check for even minute signs of fatigue, corrosion or broken rivets or welds.



Ron DittemoreSpace Shuttle Program Manager

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ATLANTIS CREW DELIVERS

exponentially more from our systems, from our hardware and from our crews with increasingly less time. And a large part of our success in these missions has to do with luck. But a larger part has to do with those of you who worked as hard or harder than we did in making sure that we had hardware and systems and a crew that were ready to do this [mission]. And so to my amazing crew ... and to all of you who stuck by us to make sure we were ready, I'd just like to thank you for that miracle."

During the mission, the STS-98 and Expedition One crews transferred 3,000 pounds of equipment and supplies to the station from *Atlantis*, including water, food, spare parts, a spare Russian carbon dioxide removal system, a spare computer, clothes, movies and other items. About 850 pounds of material was moved from the station to *Atlantis*.

Outside the spacecraft, in addition to the Destiny lab and its associated equipment, Jones and Curbeam attached about 350 pounds of equipment to the station during their three space walks, including the spare antenna and a mounting fixture for the station's Canadian robotic arm that will be launched this spring.

Curbeam thanked all for their work in making the mission a success. "The true measure of how much hard work you put in was the success that we had on our mission. We had a couple of hiccups but we got over all of them and that's because you all worked so hard and trained us so

well for so long. I know you're glad that it all came to fruition—believe me, we all had big smiles on our faces when we came back and landed at Edwards."

With the addition of Destiny, the station's mass is now 112 tons. It measures 171 feet in length, 90 feet in height and 240 feet in width. It has a volume of 13,000 cubic feet, already a larger volume than any space station in history.

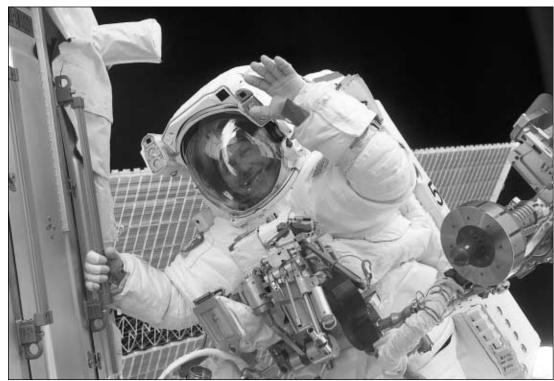
Jones was the lead space walker on the flight and served as the flight engineer for the rendezvous and docking phase and the undocking phase of STS-98. In addressing the crowd at Ellington Field, he took a step back from the flight and from the successful installation of the lab onto the space station to ponder the future.

"This is the first shuttle mission in the new century. We have a crew aboard the space station that will be the forerunners for dozens of crews to come over the next several decades. And when you think about all of that, it's science fiction come true. We have an outpost in space that's expanding with every mission that we

conduct to it. It's a dream that 35 years ago people would have just chalked up to science fiction. Here it is coming true in our lifetime. And it's just an example of what we can do when we put dreams into reality and then put our efforts and our determination and our courage collectively into an effort like this.

"And because we can do things like the space station and putting the Destiny laboratory in place, we know together that when we're asked to go to farther places, to more distant places, to more

challenging destinations, we're going to be able to put that into reality as well. So we're going to leave Earth orbit behind once the station is complete and we'll be back on the Moon, and we'll be places like the asteroids and on Mars quicker than somebody can ask us to do it if we're just given the license to do that."



STS98-E-5195

Astronaut Thomas D. Jones, STS-98 mission specialist, waves at crew mates inside Atlantis' crew cabin while working on the International Space Station (ISS) during the second of three scheduled space walks involving himself and astronaut Robert L. Curbeam and assisted by their STS-98 astronauts aboard Atlantis.